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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B32B 5/08, 5/26, D04H 13/00	A1	(11) International Publication Number: WO 00/20200 (43) International Publication Date: 13 April 2000 (13.04.00)

(21) International Application Number: PCT/US99/23003

(22) International Filing Date: 1 October 1999 (01.10.99)

(30) Priority Data:
09/165,672 2 October 1998 (02.10.98) US
09/257,447 25 February 1999 (25.02.99) US

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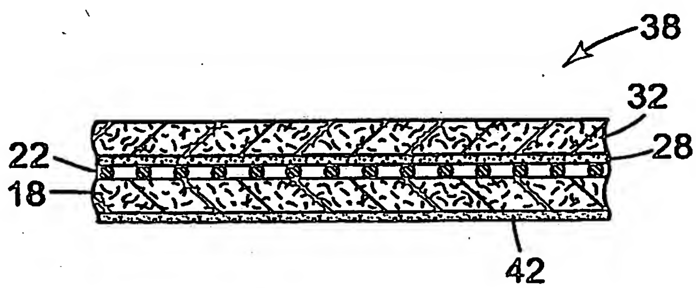
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: LAMINATED ELASTIC COMPOSITES



(57) Abstract

A laminated composite (38, 50, 60, 70, 80, 90) suitable for use in medical products such as tapes and wraps. The composite (38, 50, 60, 70, 80, 90) includes, for example, a first nonwoven fiber layer (18), an elastic layer (22), a melt blown adhesive fiber layer (28), and a second nonwoven fiber layer (32). A scrim layer (20) serves as a deadstop, or stretch limit, to prevent over stretching. The non-woven fiber layer(s) (18, 32) and/or the scrim layer (20) form suitable loops for a hook and loop fastening system. The scrim layer (20) in some embodiments is employed to make the composite finger tearable. The melt blown adhesive layer (28), nonwoven web layer (18, 32) and elastic layer (22) form a breathable, porous elastic composite. Methods of manufacturing the composite (38, 50, 60, 70, 80, 90) are also disclosed.

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LAMINATED ELASTIC COMPOSITES

FIELD OF THE INVENTION

This invention relates to laminated elastic composites that are suitable for use in tapes, wraps and bandages, and to a method of making such laminated elastic composites.

BACKGROUND OF THE INVENTION

Elastic composite materials are widely used in many forms in a large number of medical products such as tapes, wraps, bandages and wound dressings. Elastic medical products offer many advantages over non-elastic products. Elastic materials are highly conformable to body contours and serve a therapeutic purpose by applying necessary, elastically-resilient pressure over an injured or wounded area during the period that the bandage is in place. In addition, due to the elasticity in such products, they are commonly used to gently and safely immobilize wounded limbs, such as sprained ankles, without resorting to more expensive and restrictive casting methods.

Elastic bandages should preferably be absorbent so that blood and wound exudate may be removed from direct contact with a wound while it is being treated. They should also be breathable to allow for the transpiration of water vapor and other gases. In addition, they should be soft to the touch and conformable in that they readily conform to the contours of irregular surfaces such as parts of the body without crinkling, creasing or cracking. They should also be strong and have a high tensile strength. It is also desirable that elastic bandages be inexpensive and that they be made with economical materials and efficient processes.

Although all of these properties are pursued by workers in the field, it is difficult in practice to produce a single elastic composite that possesses them all, because the materials and methods that are ideally suited to provide some of the desired properties may at the same time possess countervailing qualities that prevent the achievement of others. For example, some polymeric films possess the desirable properties of strength and low cost of manufacture, yet these same films have the disadvantage of being neither breathable nor conformable.

Elastic composites are known that incorporate one or more nonwoven fiber webs as components. U.S. Patent No. 4,984,584 describes a shirred cohesive bandage that includes two nonwoven fiber web outer layers and an inner layer of substantially parallel

elastic yarns oriented in the machine direction. The fabric of the bandage is made by advancing a layer of stretched elastic yarns into a double roller apparatus, which simultaneously sandwiches the elastic yarns between two nonwoven carded webs and coats the resulting composite with a binder material. The composite is then passed through a drying oven and collected on a roll.

Elastic composites are also made by combining elastic and nonelastic nonwoven webs. For instance, U.S. Patent No. 4,863,779 describes an elastic composite comprising an elastic nonwoven fiber web thermally bonded to one or more nonelastic nonwoven fiber webs.

U.S. Patent No. 5,385,775 describes an elastic composite that includes two outer nonwoven fiber webs and an inner elastic fibrous web. The elastic fibrous web is said to comprise one layer of elastomeric melt blown fibers and one layer of parallel elastomeric filaments. The composite is made by advancing a stretched elastic nonwoven fiber web into the heated nip of a double roller apparatus where it is sandwiched between the nonwoven fiber webs and thermally bonded.

Elastic composites may also be formed by melt blowing fibers onto elastic filaments or pre-made fiber webs. U.S. Patent No. 5,219,633 (the '633 patent) describes an elastic composite that is formed in-line by extruding elastic filaments into parallel rows and then melt blowing fibers onto the elastic filaments. The two layers are then squeezed between opposing heated rollers to form a nonwoven-elastic composite. The melt blown fibers may be adhesive or pressure-sensitive adhesive fibers. Nonwoven cover webs may also be provided as additional layers in the composite. The '633 patent also discloses a method of making an elastic composite in which fibers are melt blown between two non-woven layers at the nip of a thermally bonding apparatus. The composite also includes a layer of elastic filaments, which may be extruded at the nip as well.

SUMMARY

The invention provides laminated elastic composites that include an elastic layer and a layer of fibers that are melt blown onto the elastic layer in an in-line process. The elastic layer includes a layer of substantially parallel, spaced apart elastic filaments oriented in the machine direction.

In one embodiment of the invention, the laminate composite includes a nonwoven fiber cover web and has a configuration generally represented as nonwoven // elastic // melt blown fiber.

In yet another embodiment, a second nonwoven cover web is provided, and the laminate composite has a configuration generally represented as first nonwoven // elastic // melt blown fiber // second nonwoven.

The invention also provides embodiments in which a scrim layer is included as a layer in the laminate composite.

The invention also provides a method of making elastic laminate composites. The method of the invention is practiced with an apparatus that includes a melt blowing die, a collector drum, a roll upstream from the die for dispensing a continuous length of a first nonwoven fiber web, a roll for dispensing a layer of substantially parallel elastomeric fibers upstream from the die, a roll for dispensing a second nonwoven web downstream from the die, a calender roll that forms a nip with the collector drum for thermally bonding the composite, and a winder roll for collecting the elastic composite after thermal bonding is complete.

To form an elastic composite using this apparatus, the first nonwoven fiber web and the elastic layer are dispensed from the upstream rolls and advanced over the collector drum in such a manner that the elastic filaments are situated between the nonwoven material and the die. These two layers are advanced forward and the melt blowing die deposits a layer of melt blown adhesive fibers on the elastic layer, binding together the elastic filaments to the nonwoven web and to the melt blown layer. The three layers are then advanced toward the nip formed by the collector drum and the squeezing roll. The second nonwoven fiber web is brought into contact with the exposed surface of the melt blown adhesive fibers and the composite is pressure laminated bonded as it advances through the opposing temperature controlled rollers. The elastic layer is stretched substantially beyond its relaxed state before and during lamination of the nonwoven fiber webs and scrim to the elastic layer (e.g., the elastic layer is stretched in the machine direction at least 50 percent beyond its relaxed state, and preferably 50-300%). The composite fabric is then relaxed and collected onto the winder roll.

The elastic composite made by this method comprises a first nonwoven fiber layer, an elastic layer comprising substantially parallel elastomeric filaments, a melt blown fiber adhesive layer and a second nonwoven fiber layer.

Several alternative elastic composites can be made within the method of the invention. The apparatus may be modified to include an upstream roll for dispensing a scrim that comprises spaced-apart filaments oriented in the machine direction that are substantially perpendicular to spaced-apart filaments oriented in the cross direction. Using this modified apparatus, a length of scrim material may be placed between the first nonwoven web and the elastic layer of the elastic composite. The presence of the scrim in this composite provides added tensile strength to the composite and provides the advantage of facilitating tearing in either the machine direction or the cross direction along the lines provided by the filaments.

In another alternative, the nonwoven rolls are eliminated, and the adhesive fibers are melt blown onto the elastic layer to form a composite that comprises an elastic layer comprising substantially parallel elastomeric filaments and melt blown adhesive fibers. This method may be further modified to provide a scrim layer so that the resulting composite comprises a scrim layer, an elastic layer comprising substantially parallel elastomeric filaments and a melt blown adhesive fiber layer.

The nonwoven webs and scrim of the laminated elastomeric composite also form loops useful as part of a hook and loop fastening system, and are well adapted for use with the hook system described in US Patent Application Serial No. 09/257,447, filed February 25, 1999.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of an apparatus for making an embodiment of the elastic composite of the invention.

FIG. 2 is a schematic view of an apparatus for making an embodiment of the elastic composite of the invention.

FIG. 3 is a schematic view of an apparatus for making an embodiment of the elastic composite of the invention.

FIG. 4 is a schematic view of an apparatus for making an embodiment of the elastic composite of the invention.

FIG. 5 is a schematic view of an apparatus for making an embodiment of the composite of the invention.

FIG. 6 is a top view of an embodiment of the elastic composite of the invention.

FIG. 7 is an exploded top view of the elastic composite of the invention shown in FIG. 6, showing the individual layers of the composite.

FIG. 8 is a cross sectional view of an embodiment of the elastic composite of the invention.

FIG. 9 is a cross sectional view of an embodiment of the laminated composite of the invention.

FIG. 10 is a cross sectional view of an embodiment of the laminated composite of the invention.

FIG. 11 is a cross sectional view of an embodiment of the elastic composite of the invention.

FIG. 12 is a cross sectional view of an embodiment of the elastic composite of the invention.

FIG. 13 is a top view of the weft-inserted scrim layer used in an embodiment of the elastic composite of the invention.

FIG. 14 is a cross sectional view of an embodiment of the elastic composite of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The elastic composites of the invention include a layer of substantially parallel elastomeric filaments onto which adhesive fibers have been melt blown in a single in-line method. Additional layers may be added to the composite. For instance, composites may be prepared according to the method that also include one or more nonwoven cover webs, an optional scrim layer or an outer adhesive layer.

The elastic composites of the invention are breathable, soft, strong and economical. Because of their unique combination of properties, they are suited for use in many products including medical products and consumer products. Medical products that may be improved or enhanced by incorporating the elastic composites of the invention include adhesive tapes, cohesive tapes, bandages and dressings, wraps and surgical drapes, including incise drapes which are adhered to the skin surrounding a surgical incision.

Appropriate consumer applications for the elastic composites disclosed herein include diaper tapes, diaper side panels and elastic utility tapes.

The method of making elastic composites of the invention, and the elastic composites of the invention, are explained with reference to the drawings wherein like reference numerals refer to the same or equivalent structures.

Fig. 1 is a schematic diagram illustrating the preferred apparatus and method for making elastic composites of the invention. The apparatus 10 of the method includes a die 26 for melt blowing thermoplastic fibers 28 onto collector drum 24. Nonwoven dispensing roll 12 is located upstream from the die 26 and dispenses a length of nonwoven fiber web material 18 from a continuous length roll. The nonwoven web 18 is advanced over the collector drum 24, under the die 26, through the nip 34 formed by the collector drum and the squeezing roll 36, and is collected on winder roll 40.

Elastic layer dispensing roll 16 is also located upstream from the die and dispenses a length of an elastic layer 22 from a continuous length roll over nonwoven web 18 and collector drum 24. Elastic layer 22 includes a series of spaced-apart, substantially parallel elastomeric filaments. Elastic layer 22 is stretched as it is dispensed by unwinding the elastic layer 22 at a rate that is slower than the unwind rate of the nonwoven roll 12 and the rate of rotation of collector drum 24. The stretched elastic layer 22 is advanced over the nonwoven web 18 along the same path as the nonwoven material 18 and passes under the die 26 between the nonwoven web 18 and the die 26. The elastic layer 22 is collected on winder roll 40.

Collector drum 24 rotates so as to advance the nonwoven web 18 and elastic layer 22 from the dispensing rolls 12, 16 toward the winder roll 40. As the two layers 18, 22 pass under the die, adhesive fibers 28 are melt blown onto the elastic layer 22 at high temperature. The adhesive fibers form a thermal bond with the elastomeric filaments 22 and underlying nonwoven web 18 and provide additional structural integrity due to their filamentous composition. The three layer intermediate structure is then advanced toward nip 34 formed by collector drum 24 and a calender roll 36. A second nonwoven web 32 is then dispensed from nonwoven dispensing roll 30 downstream from the die and advanced toward the nip 34 where it is placed in contact with the melt blown adhesive layer 28 forming a fourth layer 32.

The elastic composite 38 is then pressure laminated by passing it through nip 34. The tension in the composite 38 is then relaxed, and the composite assumes a shirred appearance. The composite 38 is then collected on winder roll 40. Elastic composite 38 is shown in Figs. 6-8 and includes in the following order nonwoven layer 32, melt blown adhesive layer 28, elastic layer 22, and nonwoven layer 18.

The term nonwoven web as used herein means a web of material that has been formed without the use of a weaving process. Fibers in a nonwoven web are typically laid down or deposited in a mat and are associated with each other in a random pattern. Nonwoven webs may be formed of thermoplastic fibers using several processes known in the art including melt blowing processes, spun-bonding processes, spun-lacing processes, needle punched web making processes, air laid web making processes, wet laid web making processes, film aperturing processes, and staple fiber carding processes. Nonwoven webs made by any of these processes are suitable for use as nonwoven webs 18,32 in the method of forming the elastic composite of the invention. Nonwoven webs 18, 32 are preferably pre-made nonwoven webs, which are available from a number of commercial sources. In a more preferred embodiment of the invention, nonwoven webs 18, 32 are spun-bond nonwoven webs made with thermoplastic polymers, such as the polypropylene spunbond nonwoven material available as product No. 4001720 from Avgol Nonwoven Industries, Holon, Israel. The nonwoven webs may be made of any thermoplastic polymer including, for example, polypropylene, polyester and nylon.

Nonwoven web 18 may be made of the same material as nonwoven web 32, or alternatively the webs 18, 32 may be made of different materials. In addition, nonwoven web 18 may be made by the same process as nonwoven web 32 or by an entirely different process.

The elastic layer 22 may comprise substantially parallel, substantially spaced-apart elastomeric filaments of any suitable elastomeric material characterized by the ability to stretch from its original length upon application of a force and yet substantially recover to its original length upon release of the force. The elastomeric filaments in the layer 22 are oriented with their length in the machine direction. The term machine direction, as used herein, refers to the direction of movement of the individual components of the elastic composite 38 as they are transported during the in-line method of the invention. The term cross direction, as used herein, refers to a direction perpendicular to the machine direction.

The elastomeric filaments are preferably laid across the nonwoven web 18 in the machine direction with a spacing of between about 1-30 filaments/cm in the cross direction, more preferably with a spacing of between about 1-20 filaments/cm in the cross direction, and most preferably with a spacing of between about 1-10 filaments/cm in the cross direction. Preferably, the elastic filaments have a denier in the range of about 80-800 denier, and more preferably in the range of about 200-500 denier.

Elastomeric filaments used in the elastic layer 22 may preferably be made of natural rubber, synthetic rubber or thermoplastic polymers. Suitable synthetic rubbers include ether-based polyurethane Spandex, ester-based polyurethane Spandex, SBR styrene butadiene rubber, EPDM ethylene propylene rubber, fluororubbers, silicone rubber and NBR nitrile rubber. Suitable thermoplastic elastomers for use as elastomeric filaments include block copolymers having the general formula A-B-A' where A and A' are each a thermoplastic polymer endblock which contains a styrenic moiety such as a poly (vinyl arene) and where B is an elastomeric polymer midblock such as a conjugated diene or a lower alkene polymer. The block copolymers may be, for example, (polystyrene/poly(ethylene-butylene)/polystyrene) block copolymers available from the Shell Chemical Company under the name KRATON®. Other suitable elastomeric materials include polyurethane elastomeric materials, polyamide elastomeric materials, and polyester elastomeric materials.

In the most preferred embodiment of the invention, polyurethane elastic filaments such as those available under the name GLOSPAN™ from Globe Manufacturing Company, Gastonia, N.C., are used to form the elastic layer 22.

The melt blown adhesive fibers 28 deposited from die 26 onto the elastic layer 22 are preferably melt blown pressure-sensitive adhesive fibers made according to the method discussed in Wente, Van A., "Superfine Thermoplastic Fibers," in *Industrial Engineering Chemistry,* Vol. 48,pages 1342 et seq. (1956) or in Report No. 4364 of the Naval Research Laboratories, published May 25, 1954, entitled "Manufacture of Superfine Organic Fibers" by Wente, Van A., Boone, C.D., and Fluharty, E.L, and in U.S. Patent Nos. 3,849,241 and 3,825,379, and in commonly assigned U.S. Application S.N. 08/980,541.

The melt blown pressure-sensitive adhesive fibers 28 may comprise a single layer of pressure-sensitive adhesive component. Alternatively, the pressure-sensitive adhesive fibers may comprise non-pressure-sensitive adhesive fibrous material intimately

commingled with the pressure-sensitive adhesive fibers. The commingled pressure-sensitive adhesive fibers or fibers and non-pressure-sensitive adhesive fibrous material may be present in separate individual fibers, or the pressure-sensitive adhesive fibers or fibers and the non-pressure-sensitive adhesive material may form distinct regions in a conjugate fiber and/or be part of a blend. For example, conjugate fibers can be in the form of two or more layered fibers, sheath-core fiber arrangements or in an "island in the sea" type fiber structure. In this case, one component layer would comprise the pressure-sensitive adhesive fiber or fiber and a second component layer would comprise the non-pressure-sensitive adhesive fibrous material. Generally, with any form of multicomponent conjugate fibers, the pressure-sensitive adhesive fiber component will provide at least a portion of the exposed outer surface of the multicomponent conjugate fiber. Preferably, the individual components of the multicomponent conjugate fibers will be present substantially continuously along the fiber length in discrete zones, which preferably extend along the entire length of the fibers. The individual fibers generally are of a fiber diameter of less than 100 microns, preferably less than 50 microns or 25 microns for fibers.

Conjugate melt blown fibers can be formed, for example, as a multilayer fiber as described, for example, in U.S. Patent Nos. 5,238,733; 5,601,851; or PCT Publication No. WO 97/2375. Multilayered and sheath-core melt blown fibers are described, for example, in U.S. Patent No. 5,238,733, the substance in its entirety. This patent describes providing a multicomponent melt blown fiber web by feeding two separate flow streams of polymer material into a separate splitter or combining manifold. The split or separated flow streams are generally combined immediately prior to the die or die orifice. The separate flow streams are preferably established into melt streams along closely parallel flow paths and combined where they are substantially parallel to each other and the flow path of the resultant combined multilayered flow stream. This multilayered flow stream is then fed into the die and/or die orifices and through the die orifices. Air slots are disposed on either side of a row of die orifices directing uniform heated air at high velocities at the extruded multicomponent melt streams. The hot high velocity air draws and attenuates the extruded polymeric material, which solidifies after traveling a relatively short distance from the die. The high velocity air becomes turbulent between the die and the collector surface causing the melt blown fibers entrained in the air stream to mutually entangle and

form a coherent web. The either solidified or partially solidified fibers are then collected on a surface by known methods. Also, other fibers and/or particulates can be fed into this turbulent airstream thereby getting incorporated into the forming coherent nonwoven web. This can be done, for example, by using a macrodropper, a second fiber forming die or other known methods.

Alternatively, conjugate fibers can be formed by a spunbond process such as the process described in U.S. Patent No. 5,382,400 where separate polymer flow streams are fed via separate conduits to a spinneret for producing conjugate fibers of a conventional design. Generally, these spinnerets include a housing containing a spin pack with a stack of plates that form a pattern of openings arranged to create flow paths for directing the separate polymer components separately through the spinneret. The spinneret can be arranged to extrude the polymer vertically or horizontally in one or more rows of polymers.

Suitable polymers for use in forming the melt blown pressure-sensitive adhesive fibers 28 include any thermoplastic pressure-sensitive adhesive polymer that is suitable for melt blowing processes, including those described in U.S. Application S.N. 08/980541.

In a preferred embodiment of the invention, the melt blown pressure-sensitive adhesive fibers 28 have a multilayer composition comprising one layer of a non-pressure-sensitive adhesive and one or more layers of a pressure-sensitive adhesive. In a more preferred embodiment, the melt blown pressure-sensitive adhesive fibers have a three layer construction comprising two outer layers of a pressure-sensitive adhesive and one layer of a non-pressure-sensitive adhesive. These melt blown fibers are prepared using an apparatus similar to that described in U.S. Patent Nos. 3,480,502 and 3,487,505. The gear pumps feed a three-layer feedblock (splitter) assembly connected to a melt blowing die having circular, smooth orifices. The primary air is maintained at 240°C and 241 KPa, and both the die and feedblock assembly are maintained at 240°C. The feedblock assembly is fed by two polymer melt streams, one being a melt stream of pressure-sensitive adhesive, for example, HL-1487 block copolymer PSA available from HB Fuller Company, St. Paul, MN, at 190°C, and the other being a melt stream of non-pressure-sensitive adhesive melt stream, for example, EXACT™ 4023 ultra low density polyethylene resin available from Exxon Chemicals, Bayton, TX, at 230° C. The gear pumps are adjusted to produce a 1.6 to 1.0 ratio of pressure-sensitive adhesive to non-pressure-sensitive adhesive, and the

blown fiber pressure-sensitive adhesive is directed to the elastic fiber layer 22 on the collector drum. The feedblock assembly splits the melt streams and combines them in an alternating manner into a three-layer melt stream exiting the feedblock assembly, the outermost layers of the exiting stream being the pressure-sensitive adhesive.

In an alternative preferred embodiment, the melt blown pressure-sensitive adhesive fibers 28 are single layer fibers prepared by processing a pressure-sensitive adhesive through a grid melt system such as that available from J&M Laboratories, Inc., Dawsonville, GA, and then melt blown through a blown fiber die directed at the elastic layer 22.

In a preferred embodiment of the invention the elastic composite 38 is cohesive. As used herein, the term cohesive means that a fabric has a self-adhesive property so that two or more layers when placed in contact with each other will tend to stick together. This property is particularly desirable where the cohesive, elastic composition 38 is used in medical bandages or wraps, because overlapping layers of a cohesive bandage will stick together and hold the layers of the bandage in place relative to each other, but will not stick appreciably to skin or other surfaces.

A cohesive bandage may be made according to the method of the invention by adjusting the ratio of pressure-sensitive adhesive to non-pressure-sensitive adhesive in the melt blown fiber pressure-sensitive adhesives. The cohesion of the bandage may be increased by increasing the percentage of pressure-sensitive adhesive in the melt blown fibers or by increasing the percentage of adhesive fibers in the elastic composite. Preferably, the melt blown pressure-sensitive adhesive fibers used in cohesive composites include no non-adhesive components. The increased tack of these fibers is transferred through the nonwoven surface webs 18, 32 and thus gives the elastic composite 38 a cohesive property. A single component fiber of pressure-sensitive fiber may be made using the processes of Wente, referenced above.

As used herein, the terms “fibrous adhesive” and “fibrous pressure sensitive adhesive” include melt blown fiber adhesives or pressure sensitive adhesives as well as any other fibrous adhesive.

As shown in Fig. 8, the elastic composition 38 may optionally be coated on one of its outer surfaces with a layer of pressure-sensitive adhesive 42 for use as an adhesive tape. Where an adhesive layer is applied to one of the nonwoven cover webs 18, 32, a low

adhesion backside (LAB) coating is preferably applied to the other nonwoven cover web. The LAB reduces adhesion between the adhesive and non-adhesive coated webs when the composite 38 is wound upon itself in a storage roll and thus aids in dispensing the product. Several LAB's are known in the art can achieving this purpose. For example, a suitable LAB includes a polyurethane release agent consisting of the reaction product of a 50/50 mixture of octadecyl isocyanate and a 50% hydrolyzed polyvinyl acetate.

Several variations of the method of the invention are possible without deviating from the general scope of the invention. Fig. 2 shows a schematic diagram of an alternative embodiment of the method of the invention that utilizes apparatus 100 to make an elastic composite that includes a scrim layer 20. The scrim 20, which is best shown in Fig.13, includes spaced-apart filaments 23 oriented in the machine direction that are substantially perpendicular to spaced-apart filaments 21 oriented in the cross direction. The scrim layer 20 enhances the tensile strength of the composite and facilitates hand tearing of the elastic composite in both the machine direction and the cross direction by providing tear lines along the interwoven threads. In addition, the scrim provides a deadstop, or stretch limit, which prevents over stretching of the composite. The scrim may be a weft-inserted scrim made of natural wovens, synthetic wovens, nonwovens, knits or plastics. There should be sufficient yarns in the scrim to provide regular tear lines without interfering with the elastic or other properties of the composite. The scrim may be preferably woven, knitted or extruded. Preferably, the scrim includes between about 5 and 30 threads per inch in the machine direction and between about 5 and 30 threads per inch in the cross direction.

The strands or filaments of the scrim should be spaced such that the strands enhance the finger-tearability of the composite 10 without interfering with its porosity, breathability or flexibility. The thread count of the scrim is, preferably, between 1 and 50 yarns per inch in the machine direction and between 1 and 50 yarns per inch in the cross direction, more preferably, between 1 and 30 yarns per inch in the machine direction and 1 and 30 yarns in the cross direction, and most preferably, between about 5 and 30 yarns per inch in the machine direction and between about 5 and 30 yarns per inch in the cross direction. Examples of suitable scrims include weft-inserted polyester scrims, such as those that are available from Milliken & Company, Spartanburg, NC, as Product No. 924864, 18 machine direction yarns/2.5-cm (40 denier) x 9 cross direction yarns/2.5 c-m

(150 denier), and Product No. 924916, 18 yarns machine direction yarns/2.5-cm (70 denier) x 17 cross direction yarns/2.5-cm (150 denier).

The scrim material 20 is provided on a continuous length roll 14 on the upstream side of the melt blowing die 26. In the alternative method, a length of the scrim 20 is advanced over the collector drum as an additional layer sandwiched between the first nonwoven layer 18 and the stretched elastic layer 22. Adhesive fibers 28 are melt blown onto the elastic filaments. The four layers are then advanced to the nip 34 where the melt blown adhesive 28 is covered with the second nonwoven web 32 and the resulting composite 80 is pressure laminated and collected on the winder roll 40. As best seen in Fig. 12, composite material 80 includes a first nonwoven layer 18, a scrim layer 20, an elastic layer 22, a melt blown pressure-sensitive adhesive layer 28, and a second nonwoven layer 32. The composite is elastic. The composite may optionally be provided with a pressure-sensitive adhesive 44 on one side to form a tape. If a pressure-sensitive adhesive layer 44 is used it is preferable to coat the opposite side with an LAB coating, as described above.

In another embodiment of the method of the invention, shown in the schematic diagram in Fig. 3, the apparatus 110 may be used to make an elastic composite 70, shown in Fig. 11, comprising a scrim layer 20, an elastic layer 22 and a melt blown pressure-sensitive adhesive layer 28. In this embodiment the scrim layer 20 and the stretched elastic layer 22 are advanced over the collector drum with the elastic layer 22 on top, and melt blowing die 26 deposits melt blown pressure-sensitive adhesive fibers onto the elastic layer 22. The term "stretched" in this context means stretched substantially beyond the relaxed state before and during lamination of the nonwoven fiber webs and scrim to the elastic layer (e.g., the elastic layer is stretched in the machine direction at least 50 percent beyond its relaxed state, and preferably 50-300%), and thus means stretched more than insubstantial stretching of the type that might be employed to maintain tension on the elastic layer merely for material handling purposes. The composite 70 is then advanced through the nip 34 and collected on winder roll 40. The resulting tape is both elastic and easily torn in both the machine direction and the cross direction. This embodiment may be made cohesive, as well, according to the methods described above.

In yet another embodiment of the method of the invention shown in the schematic diagram in Fig. 4, the apparatus 120 may be used to make an elastic composite 90 shown

in Fig. 14 comprising an elastic layer 22 and a melt blown pressure-sensitive adhesive layer 28. The stretched elastic layer 22 is advanced over the collector drum 24, and the die 26 deposits melt blown fibers directly onto its surface. The composite 90 is run through nip 34 and collected onto the winder roll 40. Composite 90 may be made in a cohesive form.

In addition to making elastic composite materials, the method of the invention is also suitable for making nonelastic composite materials as well. The schematic diagram in Fig. 5 illustrates a method of making a nonelastic composite material 50 suitable for use in adhesive tapes. The composite 50, shown in Fig. 9, includes a first nonwoven layer 18, a scrim layer 20, a melt blown pressure-sensitive adhesive layer 28 and a second nonwoven layer 32. The first nonwoven web 18 and the scrim layer 20 are advanced over the collector drum and under the die 26 with the scrim layer 20 on top, and the die 26 deposits melt blown pressure-sensitive adhesive fibers on the scrim layer. The three layers are then advanced toward the nip 34 by the rotating collector drum where they are covered by the second nonwoven web 32 and pressure laminated. The nonelastic composite 50 is then collected on winder roll 40. The composite 50 may preferably be coated on one of its sides with a pressure-sensitive adhesive 52 for use as a tape. If a pressure-sensitive adhesive is coated on one side of the tape, it is preferred that an LAB coating be applied to the other side.

The method of the invention may also be used to make the composite 60, shown in Fig. 10, which comprises a first nonwoven web, a scrim layer 20, and a melt blown pressure-sensitive adhesive layer 28. Composite 60 may optionally include an LAB layer 62. The composite 60 may be made as a non-elastic composite or an elastic composite without the use of elastic filaments. An elastic property may be imparted on the composite after lamination by heating the composite 60 with a hot air dryer, which causes the scrim filaments to shrink giving them an elastic property. Preferably, these elasticized filaments comprise heat-shrinkable texturized yarns.

One or more component layers (e.g., the scrim or nonwoven fiber webs) of the composite preferably form suitable loops for engaging hooks of hook and loop fastening systems, such as conventional hooks, polymeric stemmed hooks, mushroom-shaped hooks, and/or fused stems arranged in discrete regions as disclosed in US Patent Application Serial No. 09/257,447, filed February 25, 1999, which is incorporated herein

by reference. The composite provides such loops while maintaining sufficient integrity between the layers of the composite to satisfactorily handle the mechanical stresses applied by such hooks.

The plurality of the fused stems disclosed in US Patent Application Serial No. 09/257,447 extend from each of a plurality of discrete regions. The plurality of stems are preferably fused and formed to at least one major side of the composite, either by fusing on the laminated composite after formation, or fusing on one of the nonwoven fiber webs before forming the composite. The stems are configured for use as a mechanical fastener, and may have one or more different configurations and orientations. For example, the stems may have a hook formation suitable for interlocking with another hook or with a loop. Alternatively, the stems may be substantially mushroom-shaped. The stems may be oriented perpendicular to the composite, or may be oriented at an angle of less than 90 degrees to the composite. In one embodiment, the composite defines a localized plane, and the plurality of stems are oriented at multiple angles to the localized plane. At such angles, the stems provide an improved mechanical fastening effect when a force is applied parallel to the localized plane and against the angled stems. In certain embodiments, at least a portion of the composite is configured and arranged to engage the plurality of stems.

The plurality of stems can be formed of any polymer or mixture of polymers that can flow into the cavities in a stem forming tool and quench or solidify before the composite is pulled away from the tool. Useful polymers are typically thermoplastic materials, including polyurethane, polyolefins (e.g., polypropylene and polyethylene), polystyrenes, polycarbonates, polyesters, polymethacrylate, ethylene vinyl acetate copolymers, ethylene vinyl alcohol copolymers, polyvinylchloride, acrylate modified ethylene vinyl acetate polymers, and ethylene acrylic acid copolymers.

A method of making a composite having a plurality of stems extending from discrete regions or patches on the composite includes providing the composite or a nonwoven fiber web to be formed into one of the surface layers of the composite, and discrete quantities of a polymeric material in a softened state. The discrete quantities of polymeric material are fused to the composite; and a plurality of stems are formed in each discrete fused quantity of polymeric material. The discrete quantities or patches of polymeric material may be fused to the composite or web at substantially the same time

that the stems are formed. The discrete quantities of polymeric material may be provided by extruding intermittent quantities of molten polymer onto the web in forms ranging from dots to cross-web stripes. Alternatively, the discrete quantities of polymeric material may be provided by one or more rotating cutting blades.

Alternatively, the discrete regions of stems may be applied in the form of continuous stripes or ribbons. For example, the discrete regions may be arranged in continuous stripes that extend in a down-web direction in straight or zigzag patterns. In between the stripes are parts of the composite surface without stems.

A stem-forming tool has a surface with a plurality of stem-forming holes or cavities arranged in discrete regions. Part of the total surface area of the tool has such holes arranged in discrete regions while there are parts of the surface, in between regions occupied by holes, that are smooth. Alternatively, if the total surface is occupied by holes, a portion of the stem-forming cavities is masked. The composite, bearing a quantity of polymeric material in excess of the amount that would fill the cavities, is pressed against the tool surface under pressure to form regions or patches of stems on the surface of the composite. Each patch is bonded to the composite.

EXAMPLES

The following examples are offered to aid in understanding of the present invention and are not to be construed as limiting the scope thereof. Unless otherwise indicated, all parts and percentages are by weight.

TEST PROTOCOLS

Tensile Strength: ASTM Test Method No. D3759-83 was performed using a Thwing Albert tester (Model EJA/2000, Thwing Albert Company, Philadelphia, PA), a sample width of 2.54 cm, a gauge length of 5.08 cm, and a crosshead speed of 25.4 cm/min. Reported is the maximum force applied to the test sample to obtain the tensile value at point of break.

Elongation at Break: ASTM Test Method No. D3759-83 was performed using a Thwing Albert tester (Model EJA/2000, Thwing Albert Company, Philadelphia, PA), a sample width of 2.54 cm, a gauge length of 5.08 cm, and a crosshead speed of 25.4 cm/min. Reported is the maximum percent of stretch reached by the test sample at point of break.

Web Porosity: The porosity of 5.08-cm x 5.08-cm square samples was determined by measuring the time required for a known volume of air under constant pressure to pass through a known area of sample. Using a Gurley Densometer (Model 4110, Gurley Precision Instruments, Troy, NY), a sample was inserted into the orifice plates and clamped. The spring catch was disengaged lowering the inner cylinder to settle under its own weight. The time for the top of the edge of the cylinder to reach the zero line was recorded. If the cylinder did not move after 5 minutes, a value of 301 seconds was recorded. The smaller the time interval, the greater the porosity of the sample. The average results of three samples were reported.

Percent Stretch: The percent stretch of 20-cm in length x 5.08-cm in width samples was determined under a 1000-g load. A sample was laid on a flat surface and labeled with a "mark" across the sample at 12.70 cm in the relaxed state using a permanent marker. The ends of the sample were folded up. Using an apparatus with a vertical arm having a graduated scale and a fixed horizontal arm having a clamp, the top end of the sample was attached to the clamp with the jaws of the clamp perpendicular to the edge of the sample. A bottom clamp was attached to the other end of the sample and allowed to swing freely. A 1000-g weight was attached using a small hook to the bottom clamp. After the stretched sample had stabilized, the amount of stretch was measured with the graduated scale and rounded to the nearest 5%. Three separate measurements were taken and the average of these values reported.

Coverweb Bond: The coverweb bond of 20-cm in length x 5.08-cm in width samples was determined by measuring the distance the elastic strands of a sample retracted from a cut edge of the sample while in the stretched state. A sample was laid on a flat surface and labeled with a "mark" across the sample at 12.70 cm in the relaxed state using a permanent marker. The ends of the sample were folded up. Using an apparatus with a vertical arm having a graduated scale and a fixed horizontal arm having a clamp, the top end of the sample was attached to the clamp with the jaws of the clamp perpendicular to the edge of the sample. A bottom clamp was attached to the other end of the sample and allowed to swing freely. A 1000-g weight was attached using a small hook to the bottom clamp. After the stretched sample had stabilized, a sharp razor blade was used to make a cut of approximately 2.54-cm in the cross direction of the center of the sample. Using a ruler, the amount of retraction of the elastic strands from the cut was

measured to the nearest 1 mm. Three separate sample measurements were taken and the maximum distance the elastic strands retracted from the cut edge was reported.

Cohesive Strength: The cohesive strength of 15.24-cm in length x 5.08-cm in width samples was determined according to the following procedure. An Instron tensile tester was modified by using a flange with an attached hook in the upper jaw and a T-shaped aluminum block 3.18-cm in height with a 2.54-cm x 2.54-cm facing, and with a 0.8-cm wide hole drilled through the center for attaching the sample. The face of the T-shaped block was covered with SCOTCH™ No. 9589 double-coated adhesive tape (Minnesota Mining and Manufacturing Company, St. Paul, MN) so that the tape extended 0.5 cm beyond the edge of the block. The block was then placed adhesive side down onto the sample. Any sample material outside of the 2.54-cm x 2.54-cm block facing was removed with a scissors. Using the same T-block, another 2.54-cm x 2.54-cm sample was placed against the previous sample. This procedure was repeated until four layers of the sample had been attached to the T-block. The face of a second T-shaped aluminum block of the same dimensions as the first T-block was placed on top of the 4-layered sample keeping the edges of the two blocks and samples aligned. The resulting T-block set-up was then placed in a jig and compressed with a 9.067-kg weight for 60 seconds. The weight was removed and the T-block set-up was hooked to the upper jaw of the Instron using the hole in the first T-block. The lower T-block was placed directly into the lower jaw of the Instron. Using a 5.08- cm/min crosshead speed, the jaws were separated and the force required to pull the layers apart was recorded. Three samples were measured and the average of the three was reported as the cohesive strength in g/cm^2.

Hand Tearability: A test sample 2.5-cm wide x 7.5-cm long was grasped between the index finger and the thumb of both hands and torn in the cross direction of the sample. The tear line was examined for fraying and/or delamination of the composite. The amount of force required to initiate the tear was also considered. If minimal fraying and no delamination were observed in the sample, the sample demonstrated acceptable tear properties. If delamination, fraying, or large forces were necessary to initiate and propagate the tear, the sample had unacceptable or poor tear properties. For cross direction tears, the tear was rated as follows and was reported as an average of three replications:

1. Very poor tear with excessive fraying and delamination.

2. Poor tear with a large amount of fraying and delamination.
3. Average tear with some fraying and little delamination.
4. Good tear with minimal fraying and no delamination.
5. Excellent tear with no fraying and no delamination.

EXAMPLE 1

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic wrap comprising a laminate having nonwoven polypropylene outer layers, elastic filaments, and a melt blown adhesive was prepared according to the following process.

A melt blown fiber (BMF) pressure-sensitive adhesive (PSA) web comprised of three-layer polymeric fibers was prepared using a melt blowing process similar to that described, for example, in Wente, Van A., "Superfine Thermoplastic Fibers," in *Industrial Engineering Chemistry*, Vol. 48, pages 1342 et seq. (1956) or in Report No. 4364 of the Naval Research Laboratories, published May 25, 1954, entitled "Manufacture of Superfine Organic Fibers" by Wente, Van A.; Boone, C.D.; and Fluharty, E.L., except that the BMF apparatus utilized two extruders, each of which fed its extrudate to a gear pump that controlled the polymer melt flow. The gear pumps fed a three-layer feedblock (splitter) assembly similar to that described in U.S. Pat. Nos. 3,480, 502 (Chisholm, et al.) and 3,487,505 (Schrenk). The feedblock assembly was connected to a melt blowing die having circular smooth surface orifices (10/cm) with a 5:1 length to diameter ratio. The primary air was maintained at 240°C and 241 KPa with a 0.076-cm gap width to produce a uniform web. Both the die and the feedblock assembly were maintained at 240°C, and the die was operated at a rate of 178-g/hr/cm die width.

The feedblock assembly was fed by two polymer melt streams, one being a melt stream of HL-1487 block copolymer PSA (HB Fuller Company, St. Paul, MN) at 190°C and a rate of 3.64 kg/hr; and the other being a melt stream of EXACT™ 4023 ultra low density polyethylene resin (Exxon Chemicals, Bayton, TX) at 230°C and a rate of 2.27 kg/hr. The gear pumps were adjusted to produce a 1.6 to 1.0 ratio of HL 1487 PSA to polyethylene resin (based on a pump ratio percent), and the BMF-PSA web was directed to a rotating collector drum at a collector-to-die distance of 23.5 cm. The feedblock assembly split the melt streams and combined them in an alternating manner into a three-

layer melt stream exiting the feedblock assembly, the outermost layers of the exiting stream being the PSA. The resulting BMF-PSA web had a basis weight of about 50 g/m^2.

A layer of polypropylene spunbond nonwoven (17 g/m^2 basis weight, Product No. 4001720, Avgol Nonwoven Industries, Holon, Israel) and a layer of 280 denier GLOSPAN™ elastic filaments (Globe Manufacturing Company, Gastonia, NC) spaced at approximately 3.94 filaments/cm were conveyed in front of the above BMF die at a collector-to-die distance of 23.5 cm. The ratio of the filaments unwind rate to the nonwoven unwind rate was approximately 1:2.5 which resulted in the filaments stretching prior to reaching the BMF die. The two layers were positioned such that the filament layer was between the nonwoven layer and the BMF die when wrapped around the collector drum and the BMF-PSA web was blown onto the composite to bind the stretched filaments to the nonwoven. This composite was then transported approximately 38.1 cm to a nip point where another layer of polypropylene spunbond nonwoven was brought into contact with the BMF-PSA side of the construction. A nip force of 558 N was applied across a 51-cm width of composite at a nip speed of 3.8 m/min to facilitate the adhesion of all layers together. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. The resulting shirred elastic laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for test evaluations.

EXAMPLE 2

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic wrap was prepared according to the process described in Example 1, except that two layers of polyester spunlaced nonwoven (34 g/m^2 basis weight, Product No. 5601, PGI Nonwovens, Mooresville, NC) were substituted for the two polypropylene spunbond nonwoven layers. The shirred elastic laminate was very soft in feel and was observed to adhere very well to the "hook side" of a mechanical fastener, for example, Hook XMH-4132 (Minnesota Mining and Manufacturing Company, St. Paul, MN). Samples of the laminate were cut for subsequent test evaluations.

EXAMPLE 3

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Scrim//Nonwoven Laminate)

A porous elastic wrap was prepared according to the process described in Example 1, except that a weft-inserted polyester scrim layer with 18 yarns/2.5-cm (40 denier, machine-direction) and 9 yarns/2.5-cm (150 denier, cross-direction) (Product No. 924864, Milliken Company, Spartanburg, SC) was inserted between the first layer of polypropylene spunbond nonwoven and the elastic filaments layer. The three layers were wrapped around the collector drum and conveyed in front of the BMF die at a collector-to-die distance of 12.7 cm. The BMF-PSA web was blown onto the filaments side of the composite to bind the scrim and stretched filaments to the nonwoven. This composite was then transported approximately 38.1 cm to a nip point where another layer of polypropylene spunbond nonwoven was brought into contact with the BMF-PSA side of the construction. A nip force of 551 N was applied across a 51-cm width of composite at a nip speed of 3.8 m/min to facilitate the adhesion of all layers together. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. The resulting shirred elastic laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for test evaluations. The shirred elastic laminate was very soft in feel and was observed to adhere very well to the "hook side" of a mechanical fastener, for example, Hook XMH-4132 (Minnesota Mining and Manufacturing Company, St. Paul, MN). A 5.1-cm wide x 10.2-cm long sample was observed to tear evenly across the width of the sample and left a very clean edge.

EXAMPLE 4

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic wrap comprising a laminate having nonwoven polypropylene outer layers, elastic filaments, and a melt blown adhesive was prepared according to the following process.

A BMF-PSA web comprised of HL-8156 block copolymer PSA (HB Fuller Company) was prepared by processing the solid adhesive through a grid melt system (J&M Laboratories, Inc., Dawsonville, GA) and then through a 30.5-cm wide BMF die at a rate of 0.86 kg/hr. The grid melt system had a hopper holding capacity of 40 kg and a melting capacity of 40 kg/hr. The melt pump volume was 1.68 cc/rev. and the process temperature was 160° C. The BMF-PSA was discharged from the die approximately 25.9 cm above a vertical nip point formed by two 40.6-cm wide silicone coated rolls.

A layer of polypropylene spunbond nonwoven (15 g/m^2 basis weight, Product No. 3615, Freudenberg Spunwebs, Kaiserslautern, Germany) was fed around the bottom roller of the nip from the "up-stream" side of the BMF die. At the same time, a second layer of polypropylene spunbond nonwoven (Product No. 3615) and a layer of 280 denier GLOSPAN™ elastic filaments was fed around the top roller of the nip from the "down-stream" side of the BMF die. The collector-to-die distance was 25.9 cm. The elastic filaments had a cross-web density of 2.75 filaments/cm and a stretch ratio of 2.5:1. The filaments were situated on top of the nonwoven layer so that the BMF-PSA was blown onto the "up-stream" layer of nonwoven and then contacted the elastic filaments to bond the entire composite together. The nip force was 418 N across a 30.5-cm wide composite and the nip speed was 9.1 m/min. After passing through the nip, the final construction of the laminate was: nonwoven//BMF-PSA//elastic filaments//nonwoven. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. It was observed that the low baseweight nonwoven outer layers ("coverwebs") and flexible BMF-PSA fibers were easily buckled into soft pleats. The resulting shirred elastic laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for test evaluations.

EXAMPLE 5

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic wrap comprising a laminate having nonwoven polypropylene outer layers, elastic filaments, and a melt blown adhesive was prepared according to Example 4, except that GLOSPAN™ 420 denier elastic filaments were used in place of the GLOSPAN™ 280 denier filaments and HL-1470 block copolymer PSA (HB Fuller) was used in place of the HL-8156 adhesive. The resulting shirred elastic laminate was collected and cut into samples for test evaluations.

EXAMPLE 6

Porous Elastic Cohesive Bandage

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic cohesive bandage comprising a laminate having nonwoven polypropylene and nonwoven nylon outer layers, elastic filaments, and a melt blown adhesive was prepared according to the following process.

A BMF-PSA web was prepared essentially as described in Example 1, except that EASTOFLEX™ D-127 polyalphaolefin PSA (Eastman Chemical, Kingsport, TN) was extruded as a single component BMF-PSA. Both the die and feedblock assembly were maintained at 190°C and the die was operated at a rate of 92-g/hr/cm die width. The adhesive melt stream was fed to the feedblock at a rate of 4.54 kg/hr and at a temperature of 190° C. The primary air was maintained at 220°C and 138 KPa with a 0.076 cm gap width, to produce a uniform web. The resulting BMF-PSA web was directed to a rotating collector drum at a collector-to-die distance of 12.8 cm and had a basis weight of about 39 g/m^2.

A layer of polypropylene spunbond nonwoven (10 g/m^2 basis weight with 2 denier fibers and a 10% bond pattern, Hills Ason, West Melbourne, FL) and a layer of 280 denier GLOSPAN™ elastic filaments (Globe Manufacturing Company) spaced at approximately 2.74 filaments/cm (each section of filament had two elastic yarns) were conveyed in front of the above BMF die at a collector-to-die distance of 20.3 cm. The ratio of the filaments unwind rate to the nonwovens unwind rate was approximately 3:1 which resulted in the filaments stretching prior to reaching the BMF die. The two layers were positioned such that the filament layer was between the nonwoven layer and the BMF die when wrapped around the collector drum and the BMF-PSA web was blown onto the composite to bind the stretched filaments to the nonwoven. This composite was then transported approximately 38.1 cm to a nip point where another layer of polypropylene spunbond was brought into contact with the BMF-PSA side of the construction. A nip force of 1958 N was applied across a 50.8-cm width of composite at a nip speed of 4.6 m/min to facilitate the adhesion of all layers together. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. The resulting shirred elastic laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for test evaluations.

It was observed that the BMF-PSA squeezed through the nonwoven outer layers and remained on the outer surfaces of the laminate. When two samples of laminate came into contact with each other a cohesive bond was formed between the two laminates. The two laminates could easily be removed from one another and when rejoined together continued to exhibit cohesive properties. This joining together and separating of two laminate samples could be repeated a number of times in succession.

EXAMPLE 7

Porous Elastic Cohesive Bandage

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic cohesive bandage comprising a laminate having nonwoven nylon outer layers, elastic filaments, and a melt blown adhesive was prepared according to Example 4, except that the BMF-PSA adhesive was HL-1470 (HB Fuller), the elastic filaments were GLOSPAN™ 420 denier filaments, and the nonwoven outer layers were nylon spunbond nonwoven (10 g/m^2 basis weight, designated PBN-II type 303, Cerex Advanced Fabrics, L.P., Pensacola, FL). A nip force of 2631 N was applied across a 35.5-cm width of composite at a nip speed of 6.1 m/min to facilitate the adhesion of all layers together. The BMF-PSA basis weight was 18 g/m^2 and the elastic filaments stretch ratio was 3:1. The resulting shirred elastic laminate was collected and cut into samples for test evaluations. The laminate was observed to have cohesive properties as described for the laminate of Example 6.

EXAMPLE 8

Porous Elastic Cohesive Bandage

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic cohesive bandage comprising a laminate having nonwoven polyester outer layers, elastic filaments, and a melt blown adhesive was prepared according to Example 4, except that the BMF-PSA adhesive was HL-1470 (HB Fuller), the elastic filaments were GLOSPAN™ 420 denier filaments, and the nonwoven outer layers were carded polyester webs with acrylic resin binder (12 g/m^2 basis weight, Minnesota Mining and Manufacturing Company, St. Paul, MN). A nip force of 438 N was applied across a 35.5-cm width of composite at a nip speed of 6.1 m/min to facilitate the adhesion of all layers together. The BMF-PSA basis weight was 13 g/m^2 and the elastic filaments stretch ratio was 3:1. The resulting shirred elastic laminate was collected and cut into samples for test evaluations. The laminate was observed to have cohesive properties as described for the laminate of Example 6.

EXAMPLE 9

Porous Elastic Cohesive Bandage

(Nonwoven//BMF-PSA//Filaments//Nonwoven Laminate)

A porous elastic cohesive bandage comprising a laminate having nonwoven polyester outer layers, elastic filaments, and a melt blown adhesive was prepared according to Example 4, except that the nonwoven outer layers were comprised of the polyester nonwoven used in Example 8. A nip force of 2631 N was applied across a 35.5-cm width of composite at a nip speed of 6.1 m/min to facilitate the adhesion of all layers together. The BMF-PSA basis weight was 16 g/m^2 and the elastic filaments stretch ratio was 2:1. The resulting shirred elastic laminate was collected and cut into samples for test evaluations. The laminate was observed to have cohesive properties as described for the laminate of Example 6.

EXAMPLE 10

Porous Adhesive Tape

(Nonwoven//BMF-PSA//Scrim//Nonwoven//PSA Laminate)

A porous, adhesive tape comprising a laminate having nonwoven polypropylene outer layers, a weft-inserted scrim, a melt blown adhesive, and a PSA coating was prepared according to the following process.

A single component BMF-PSA web comprised of EASTOFLEX™ D-127 polyalphaolefin PSA (Eastman Chemical) polymeric fibers was prepared essentially as described in Example 6. The resulting BMF-PSA web had a basis weight of about 15 g/m^2. A layer of polypropylene spunbond nonwoven (15 g/m^2 basis weight, Product No. 3615, Freudenberg Spunwebs, Kaiserslautern, Germany) was wrapped around a collector drum in front of the BMF die at a collector-to-die distance of 23.5 cm. A weft-inserted polyester scrim layer (Product No. 924864, Milliken Company) was then wrapped around the collector drum on top of the nonwoven layer. The two layers were positioned such that the scrim layer was between the nonwoven layer and the BMF die and the BMF-PSA web was blown onto the composite to bind the scrim layer to the nonwoven. This composite was then transported approximately 38.1 cm to a nip point where another layer of polypropylene spunbond nonwoven was brought into contact with the BMF-PSA side of the construction. A nip force of 558 N was applied across a 51-cm width of composite at a nip speed of 2.7 m/min to facilitate the adhesion of all layers together. The resulting

laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for coating with a PSA layer.

An acrylate adhesive comprised of 60% isooctyl acrylate/acrylic acid copolymer (94/6 weight ratio) (Minnesota Mining and Manufacturing Company, St. Paul, MN) and 40% FORAL™ 85 rosin ester (supplied as a 35% solids in heptane/isopropyl alcohol (90/10 volume ratio), Hercules, Inc., Wilmington, DE) was solvent coated onto a silicone release liner (Product No. 2-60BKG-157&99AM, Daubert, Dixon, IL). The adhesive coating of 50 micrometers/10.16-cm x 15.24-cm area was prepared with a 25.4-cm wide knife coater at a gap of 10 mils. The adhesive-coated liner was dried using a dual oven system with the first oven at 46°C and the second oven at 76°C. The acrylate adhesive was then transferred to the outer nonwoven layer ("scrim-side") of the laminate described above with a heated laminating roll at 38°C and 621 KPa. The resulting adhesive-coated laminate was cut into samples and evaluated (machine direction) for tensile strength at break, percent elongation at break, porosity. Hand tearability was evaluated in the cross direction. The results are shown in Table 1.

EXAMPLE 11

Porous Adhesive Tape

(Nonwoven//Scrim//BMF-PSA//PSA Laminate)

A porous adhesive tape comprising a laminate having nonwoven polypropylene outer layer, a weft-inserted scrim, a melt blown adhesive, and a PSA coating was prepared according to the following process.

A BMF-PSA web was prepared essentially as described in Example 4, except that the HL-1470 PSA (HB Fuller) was substituted for the HL-8156 adhesive. The resulting BMF-PSA web had a basis weight of about 13 g/m^2.

A layer of polypropylene spunbond nonwoven (17 g/m^2 basis weight, Avgol Nonwoven Industries, Holon, Israel) was fed around a bottom roller of a laminator from the "down-stream" side of the BMF die at a collector-to-die distance of 10.2 cm. A weft-inserted polyester scrim layer (knitted with 70-denier texturized polyester yarn in the chain and the weft with a knit density of 4 chain yarns/cm and 3.8 weft yarns/cm) was then unwound from the same side of the laminator as the nonwoven layer and located such that the BMF-PSA web was blown onto the scrim layer. A third layer of silicone release liner (Product No. 2-43MG-1F, Daubert Coated Products, Inc., Westchester, IL) was wound on

the adhesive side of the composite to help prevent the adhesive from contacting the nip rollers. The composite passed through the nip at a nip force of 900 N across a 30.5-cm wide composite and at a nip speed of 4.57 m/min. The composite was heated with a hot air gun which caused the texturized yarns to heat shrink. As the texturized yarns shrunk from the heat, the composite shirred in a manner similar to composites containing elastic filaments.

The resulting laminate was collected by winding around a 7.62-cm cardboard core and was subsequently cut into samples for coating with a PSA layer.

A PSA layer was transferred onto the BMF-PSA web layer (release liner removed) of the above laminate by utilizing the same PSA and the same coating/transfer process as described in Example 10. The resulting adhesive-coated laminate was then coated on the nonwoven outer layer with a low adhesion backside (LAB) to improve the unwind characteristics of the laminate. The LAB utilized a polyurethane release agent consisting of the reaction product of a 50/50 mixture of octadecyl isocyanate and a 50% hydrolyzed polyvinyl acetate. The polyurethane was dissolved at 5% solids in a heptane/xylene/isopropyl alcohol solvent (72/25/3 volume ratio) and then solvent coated onto the laminate using a 80-line knurled roll with rubber backup roll at 138 KPa and a line speed of 3.7 m/min. The LAB-coated laminate was dried using the dual oven system described in Example 10. The resulting LAB coating weight was approximately 12 micrometers per a 10.16-cm x 15.24-cm area.

The resulting porous adhesive tape was cut into samples and evaluated (machine direction) for tensile strength at break, percent elongation at break, and porosity. Hand tearability was measured in the cross direction. The results are shown in Table 1.

EXAMPLE 12

Porous Elastic Cohesive Wrap

(BMF-PSA//Filaments Laminate)

A porous elastic cohesive wrap comprising a laminate having elastic filaments and a melt blown pressure-sensitive adhesive was prepared according to the following process.

A BMF-PSA web comprised of three-layer polymeric fibers was prepared essentially as described in Example 1, except that HL-2547 block copolymer PSA (HB Fuller) was substituted for the HL-1487 adhesive, a polyurethane polymer (Product No. PS440-200, Morton International, Seabrook, NH) was substituted for the EXACT™ 4023

polyethylene resin, and the following process conditions were used. Both the die and the feedblock assembly were maintained at 225°C, and the die was operated at a rate of 128-g/hr/cm die width. The HL-2547 PSA melt stream was fed to the feedblock at 190°C and a rate of 1.95 kg/hr, and the polyurethane melt stream was fed to the feedblock at 225°C and a rate of 4.54 kg/hr. The gear pumps were adjusted to produce a 0.43 to 1.0 ratio of HL-2547 PSA to polyurethane resin, and the BMF-PSA web was directed to a rotating collector drum at a collector-to-die distance of 7 cm. The resulting BMF-PSA web had a basis weight of about 100 g/m^2.

A layer of 280 denier GLOSPAN™ elastic filaments (Globe Manufacturing Company) spaced at approximately 3.94 filaments/cm were conveyed in front of the above BMF die at a collector-to-die distance of 23.5 cm. The ratio of the collector speed to the filaments unwind rate was approximately 2.5:1 which resulted in the filaments stretching prior to reaching the BMF die. This composite was then transported approximately 38.1 cm to a nip point where a nip force of 251 N was applied across a 51-cm width of composite at a nip speed of 2.1 m/min to facilitate the adhesion of the filaments to the BMF-PSA web. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. A 7.62-cm x 2.54-cm sample of the laminate was removed, wrapped around a 1.27-cm diameter cylinder, and subsequently utilized for test evaluations. When two samples of laminate came into contact with each other a cohesive bond was formed between the two laminates. The two laminates could easily be removed from one another without tearing and when rejoined together continued to exhibit cohesive properties. This joining together and separating of two laminate samples could be repeated a number of times in succession.

EXAMPLE 13

Porous Elastic Cohesive Wrap

(BMF-PSA//Filaments/Scrim Laminate)

A porous elastic cohesive wrap comprising a laminate having elastic filaments, a weft-inserted scrim, and a melt blown pressure-sensitive adhesive was prepared according to the following process.

A BMF-PSA web comprised of three-layer polymeric fibers was prepared essentially as described in Example 1, except that HL-2547 block copolymer PSA (HB Fuller) was substituted for the HL-1487 adhesive, a polyurethane polymer (Product No.

PS440-200, Morton International, Seabrook, NH) was substituted for the EXACT™ 4023 polyethylene resin, and the following process conditions were used. Both the die and the feedblock assembly were maintained at 235°C, and the die was operated at a rate of 177-g/hr/cm die width. The HL-2547 PSA melt stream was fed to the feedblock at 190°C and a rate of 3.15 kg/hr, and the polyurethane melt stream was fed to the feedblock at 235°C and a rate of 5.84 kg/hr. The gear pumps were adjusted to produce a 0.54 to 1.0 ratio of HL-2547 PSA to polyurethane resin, and the BMF-PSA web was directed to a rotating collector drum at a collector-to-die distance of 7.6 cm. The resulting BMF-PSA web had a basis weight of about 55 g/m^2.

A layer of 280 denier GLOSPAN™ elastic filaments (Globe Manufacturing Company) spaced at approximately 3.94 filaments/cm, a weft-inserted polyester scrim layer (Product No. 924864, Milliken Company), and a pre-made layer of the above BMF-PSA web were wrapped around a collector drum such that the BMF-PSA web layer contacted the drum and the filaments were sandwiched between the scrim and the BMF-PSA web. The ratio of the collector speed to the filaments unwind rate was approximately 2:1 which resulted in the filaments stretching prior to reaching the BMF-PSA web. This composite was then transported approximately 38.1 cm to a nip point where a nip force of 558 N was applied across a 51-cm width of composite at a nip speed of 5.2 m/min to facilitate the adhesion of the filaments to the BMF-PSA web. Upon exiting the nip, the laminate was allowed to relax thereby causing the filaments to contract. The resulting laminate was collected as described in Example 12 and subsequently utilized for test evaluations. A 5.1-cm wide x 10.2-cm long sample was observed to tear evenly across the width of the sample and left a clean edge. When two samples of laminate came into contact with each other a cohesive bond was formed between the two laminates. The two laminates could easily be removed from one another without tearing and when rejoined together continued to exhibit cohesive properties. This joining together and separating of two laminate samples could be repeated a number of times in succession.

EXAMPLE 14

Porous Elastic Adhesive Tape

(Nonwoven//Filaments//Scrim//BMF-PSA Laminate)

A porous, elastic adhesive tape comprising a laminate having one nonwoven polypropylene outer layer, elastic filaments, a weft-inserted scrim, and a melt blown adhesive was prepared according to the following process.

A BMF-PSA web was prepared essentially as described in Example 4. The resulting BMF-PSA web had a basis weight of about 56 g/m^2.

A layer of polypropylene spunbond nonwoven (17 g/m^2 basis weight, Product No. 4001720, Avgol Nonwoven Industries, Holon, Israel) was fed around a bottom roller of a laminator from the "down-stream" side of the BMF die at a collector-to-die distance of 22 cm. A layer of 280 denier GLOSPAN™ elastic filaments (Globe Manufacturing Company) spaced at approximately 3.94 filaments/cm were conveyed in front of the BMF die at a collector-to-die distance of 22 cm. The ratio of the collector speed to the filaments unwind rate was approximately 2.5:1 which resulted in the filaments stretching prior to reaching the BMF die. A weft-inserted polyester scrim (Product No. 924864, Milliken) was then wrapped around the collector drum on top of the filaments layer and located such that the BMF-PSA web was blown onto the scrim layer. The composite passed through the nip point with a nip force of 1754 N across a 35.6-cm wide composite and at a nip speed of 12.2 m/min. The resulting laminate was collected in its relaxed state by winding around a 7.62-cm cardboard core and was subsequently cut into samples for test evaluations.

EXAMPLE 15

Porous Elastic Wrap

(Nonwoven//BMF-PSA//Filaments//Hydrophilic Nonwoven Laminate)

A porous elastic wrap comprising a laminate having one nonwoven polypropylene outer layer, one hydrophilic nonwoven outer layer, elastic filaments, and a melt blown adhesive was prepared according to Example 4, except that GLOSPAN™ 420 denier elastic filaments (Globe Manufacturing Company) were used in place of the GLOSPAN™ 280 denier filaments, HL-1470 adhesive (HB Fuller) was used in place of the HL-8156 adhesive, and a hydrophilic polyester needletacked nonwoven (TYPELLE™ nonwoven, 48 g/m^2 basis weight, Reemay Nonwovens, Old Hickory, TN) was used in place of the

second nonwoven polypropylene outer layer. The resulting shirred elastic laminate was collected and subsequently cut into samples for test evaluations.

TEST DATA

The porous elastic wraps from Examples 1-5 were cut into appropriate sample sizes and evaluated (machine direction) for Tensile Strength, Percent Elongation at Break, Coverweb Bond, Percent Stretch, and Porosity. The porous elastic wrap from Example 15 was evaluated for Tensile Strength, Percent Elongation at Break, Percent Stretch, Porosity, and in the cross direction, Hand Tearability. Results are provided in Table 1 and are compared with results for the commercial tapes. In the table, NA=Not Applicable and NM=Not Measured.

The porous elastic cohesive wraps from Examples 6-9 and 12-13 were cut into appropriate sample sizes and evaluated (machine direction) for Tensile Strength, Percent Elongation at Break, Coverweb Bond, Percent Stretch, Cohesive Strength, and Porosity. Results are provided in Table 1 and are compared with results for the commercial tapes, COBAN™ cohesive wrap (Minnesota Mining and Manufacturing Company, St. Paul, MN) and COFLEX™ cohesive wrap (Andover, Salisbury, MA).

The porous adhesive tapes from Examples 10, 11, and 14 were cut into appropriate sample sizes and evaluated (machine direction) for Tensile Strength, and Percent Elongation at Break and Porosity. Hand Tearability was evaluated in the cross direction. Results are provided in Table 1.

Additionally, the results for samples from Examples 1-15 are compared in Table 1 with results for the commercial tapes, ACE bandage (Johnson & Johnson, Arlington, TX), FLEXUS™ cohesive wrap (Kimberly-Clark, Roswell, GA), COBAN cohesive wrap (Minnesota Mining and Manufacturing Company, St. Paul, MN), ELASTOPLAST™ adhesive tape (Johnson & Johnson), and LIGHTPLAST™ adhesive tape (Beiersdorf-Jobst, Inc., Charlotte, NC).

Table 1
Evaluation Results for Elastic Wraps (Examples 1-5, 15), Elastic Cohesive Wraps (Examples 6-9, 12-13) and Adhesive Tapes (Examples 10-11, 14)

Example	Tensile Strength (N/2.5 cm)	Elongation (%)	Coverweb Bond (mm)	Stretch (%)	Cohesive Strength (g/cm^2)	Porosity (sec)	Tear (Rating 1-5)
1	45±8	220 ±24	0	121±5	NA	0.13+.05	NA
2	112±5	146 ±11	4±2	93±12	NA	0.18+.05	NA
3	98±5	97 ±2	0	50±10	NA	0.10	NA
4	93±5	117 ±9	0	135±3	NA	0.10	NA
5	36±3	324 ±18	18±5	>160	NA	0.10	NA
6	100±4	107±7	0	52±6	2±1	0.7±0.2	NA
7	56±14	168±38	1.3±1	70	33±2	0.1	NA
8	29±1	152±34	2.0±1	127±28	17±2	0.1±0.1	NA
9	32±6	131±8	3.7±2	103±6	22±8	0.1	NA
10	105±3	26 ±1	NA	NA	NA	5.4±2	2
11	88±10	31±1	NA	NA	NA	111±14	2
12	63±11	130±8	0	60	31±2	0.2±.05	NA
13	15±1	314±13	0	96±17	4±1	0.2±.05	NA
14	79±4	113±3	NM	85±5	NA	0.4±.1	2
15	81±1	355±15	NM	72±2	NA	0.2±.05	1
ACE™	220±46	150 ±03	0	150+8	NA	0.20	NA
FLEXUS™	36±4	187 ±11	0	106+4	NA	0.23+.05	NA
COBAN™	48±2	180±12	0	115±5	93±11	0.1	NA
COFLEX™	49±6	280±20	0	143±3	64±8	0.1	NA
ELASTOPLAST™	213±5	94±6	0	8±1	NA	87±2	1
LIGHTPLAST™	54±2	95±8	0	83±2	NA	1±1	2

It can be concluded from the test results provided in Table 1 that constructions for the elastic non-cohesive wraps, elastic cohesive wraps, and adhesive tapes of this invention possess the necessary tensile strength, elongation, porosity, and tear properties that are required for conventional medical bandage and tape applications. It is clear that a wide range of desirable physical properties can be achieved by tailoring the melt blown adhesive, the weft-inserted scrim, the elastic filaments, and the processing conditions to meet a particular end-use objective.

What is claimed is:

1. A laminated elastic composite, comprising:

(a) a first nonwoven web layer having a machine direction and a cross direction;

(b) a scrim layer adjacent to the first nonwoven web layer comprising spaced-apart, nonelastic filaments oriented substantially in the machine direction that are substantially perpendicular to spaced-apart filaments oriented substantially in the cross-direction;

(c) an elastic layer adjacent to the scrim layer comprising a series of substantially parallel, spaced-apart elastic filaments wherein the length of the elastic filaments are oriented substantially in the machine direction;

(d) a fibrous pressure sensitive adhesive layer adjacent the elastic layer; and

(e) a second nonwoven web layer adjacent to the fibrous pressure sensitive adhesive layer.

2. A laminated elastic composite according to claim 1, wherein the first nonwoven layer is a nonwoven material selected from the group consisting of a melt blown nonwoven material, a spunbond nonwoven material, a spun laced nonwoven material, a staple carded web, an air laid web and a wet laid web, and wherein the second nonwoven layer is a nonwoven material selected from the group consisting of melt blown nonwoven materials, spunbond nonwoven materials, spun laced nonwoven materials, staple carded webs, air laid webs and wet laid webs.

3. A laminate composite, comprising:

(a) a first nonwoven web layer;

(b) a scrim layer adjacent to the first nonwoven web layer comprising spaced-apart, non-elastic filaments oriented substantially in the machine direction that are substantially perpendicular to spaced-apart filaments oriented in the cross-direction; and

(c) a fibrous pressure sensitive adhesive layer adjacent the scrim layer.

4. A laminated composite according to claim 3, further comprising:

(a) a pressure-sensitive adhesive layer adjacent to the fibrous pressure sensitive adhesive layer.

5. A laminated composite according to claim 3 or 4, wherein the nonwoven layer comprises a nonwoven material selected from the group consisting of a melt blown nonwoven material, a spunbond nonwoven material, a spun laced nonwoven material, a staple carded web, an air laid web and a wet laid web.

6. An elastic laminated composite, comprising:

(a) a scrim layer comprising spaced-apart filaments oriented substantially in the machine direction that are substantially perpendicular to spaced-apart filaments oriented substantially in the cross-direction.

(b) an elastic layer comprising a series of substantially parallel, spaced-apart elastic filament wherein the elastic filaments are oriented substantially in the machine direction; and

(c) a fibrous pressure sensitive adhesive layer adjacent the elastic layer.

7. A laminated composite according to any of claims 1-6, wherein the fibrous pressure sensitive adhesive layer comprises a melt blown fiber layer including pressure sensitive adhesive fibers.

8. A laminated composite according to claim 7, wherein the melt blown fiber adhesive layer comprises multilayer fibers comprising one or more layers of a pressure-sensitive adhesive and one or more layers of a non-adhesive polymer.

9. A laminated composite according to any of claims 1-8, wherein the scrim or nonwoven fiber layer forms loops, and further comprising a plurality of hooks formed along a surface of the composite for releasable engagement with the loops to fasten the composite in use.

10. A method of making an elastic laminate composite, comprising the steps of:

(a) providing a melt blowing apparatus comprising a die and a rotating collector drum;

(b) providing a first nonwoven web overlaying the collector drum, wherein the nonwoven web comprises a material selected from the group consisting of a melt blown nonwoven material, a spunbond nonwoven material, a spun laced nonwoven material, a staple carded web, an air laid web and a wet laid web;

(c) providing a scrim overlaying the nonwoven web and the collector drum comprising spaced-apart filaments oriented substantially in the machine direction that are perpendicular to spaced-apart filaments oriented substantially in the cross direction;

(d) providing a series of substantially parallel, spaced-apart elastic filaments overlaying the nonwoven web and scrim on the collector drum, wherein the elastic filaments are oriented substantially in the machine direction and wherein the elastic filaments are stretched at least 50% beyond their relaxed length;

(e) advancing the first nonwoven material, scrim and the overlaying stretched elastic filaments to a position beneath the melt blowing die by rotating the collector drum;

(f) melt blowing fibers comprising a pressure-sensitive adhesive from the die onto the elastic filaments;

(g) providing a second nonwoven web downstream from the die wherein the second nonwoven web comprises a material selected from the group consisting of a melt blown nonwoven material, a spunbond nonwoven material, a spun laced nonwoven material, a staple carded web, an air laid web and a wet laid web;

(h) pressure laminating the second nonwoven web onto the blown fiber adhesive filaments, the elastic filaments and the first nonwoven web, by advancing the layers through a nip formed between the

collector drum and a calender roll to form an elastic laminate composite comprising the first nonwoven web, the elastic filaments, the blown fiber pressure-sensitive adhesive web and the second nonwoven web; and

(i) allowing the stretched elastic filaments to relax and collecting the elastic laminate composite on a winder roll.

11. A method according to claim 10 wherein the elastic filaments are stretched between 50-300 percent.

12. A method according to claim 10 or 11 further comprising forming a plurality of hooks on the elastic laminate composite.

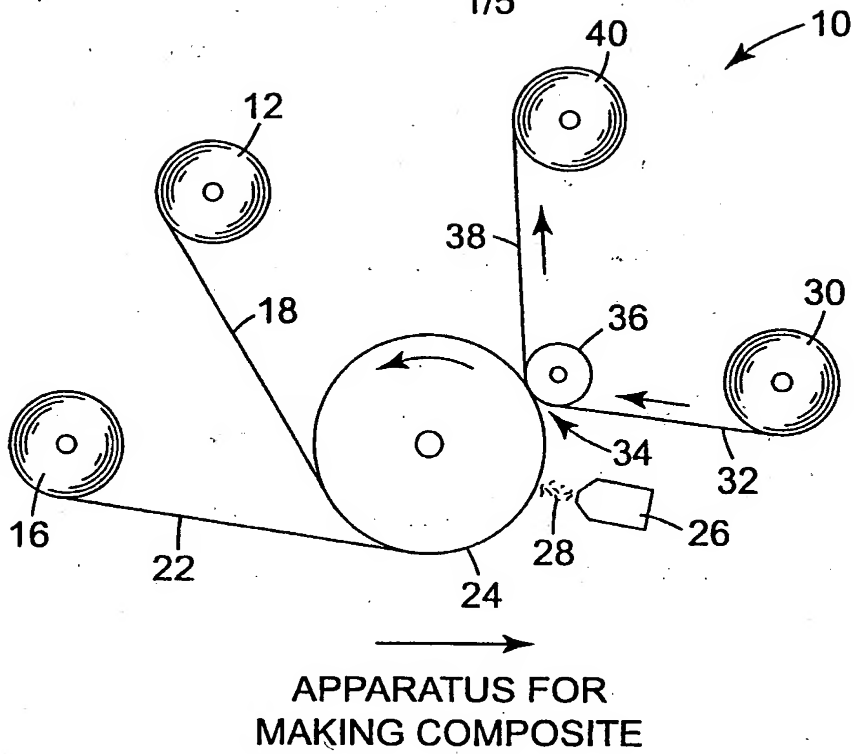
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Fig. 1

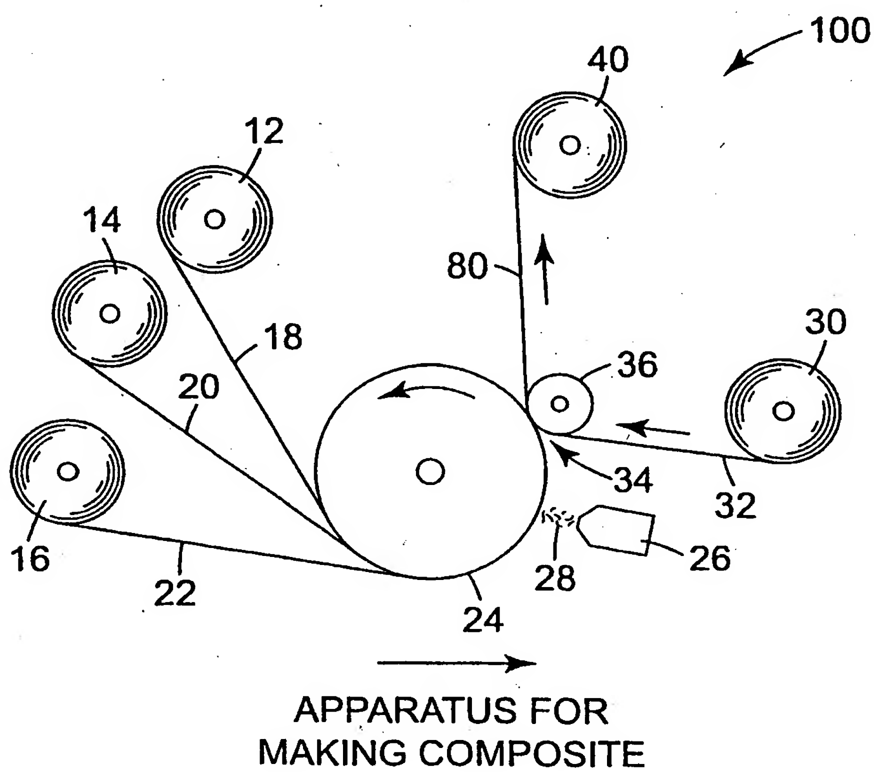
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Fig. 2

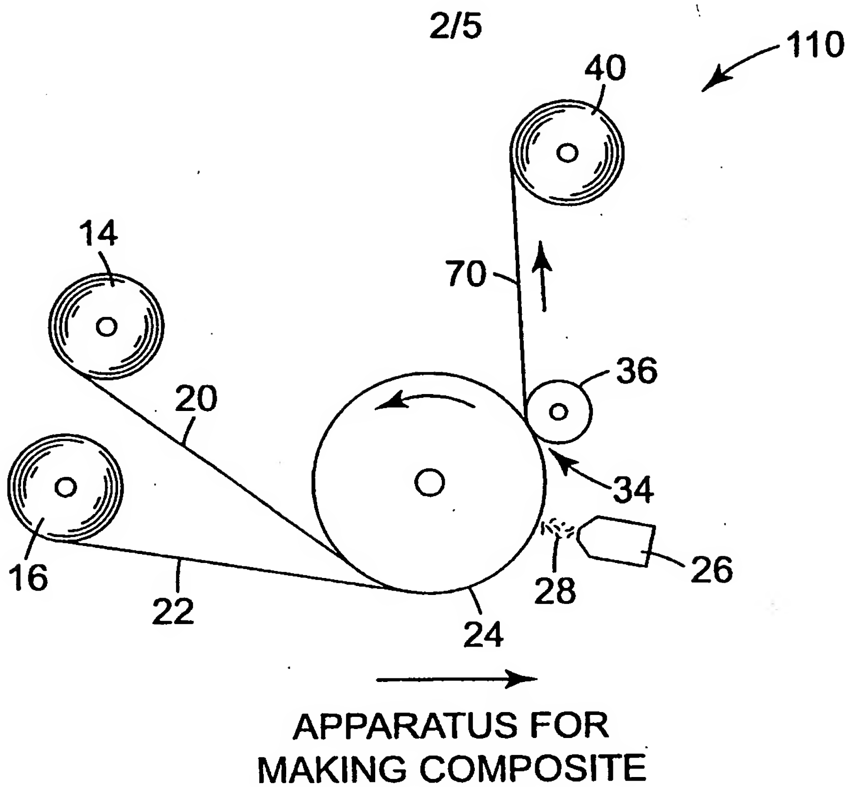
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Fig. 3

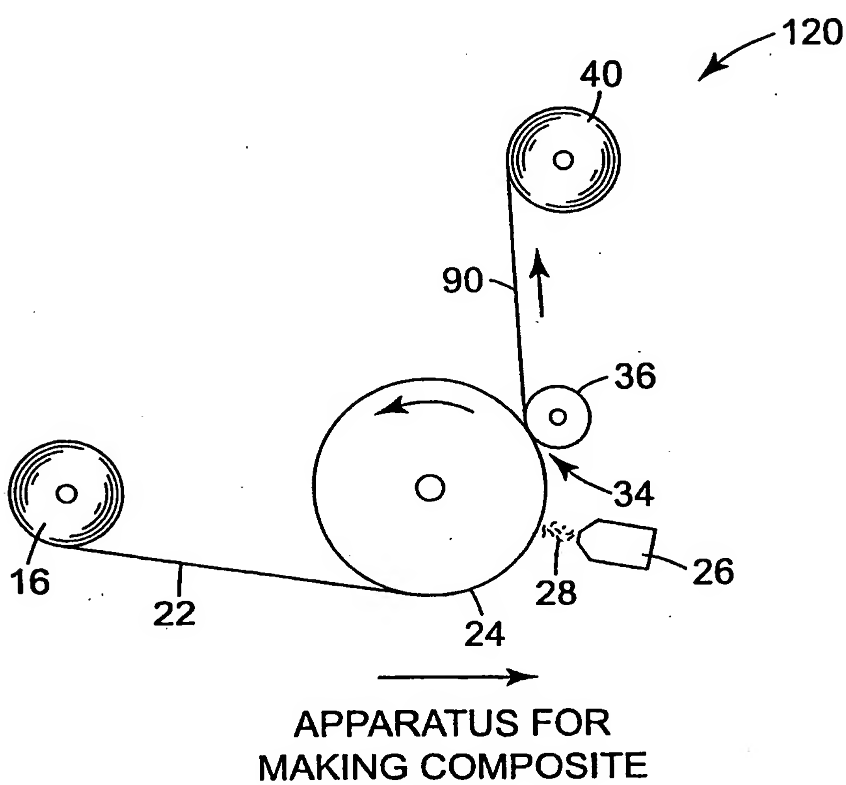
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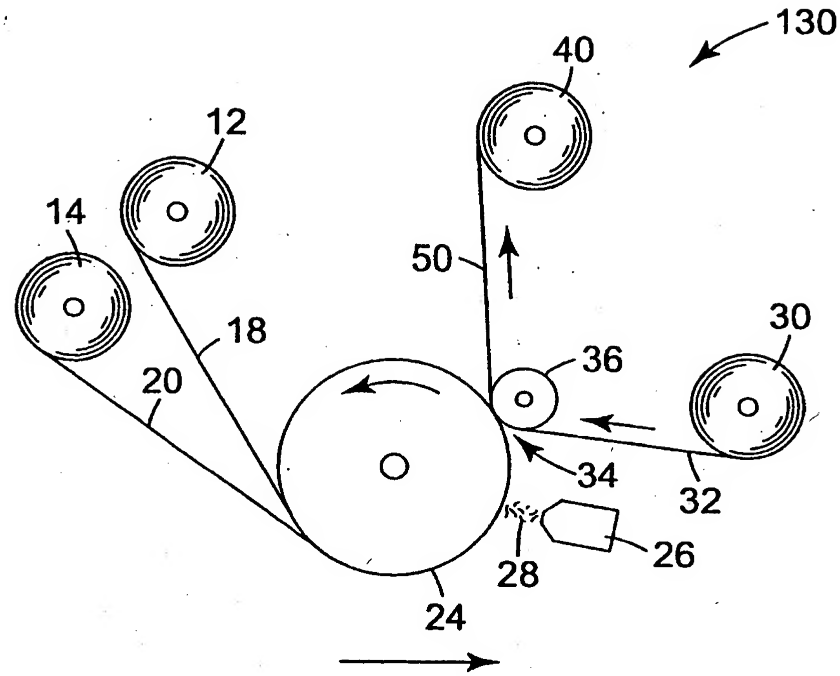
Fig. 4



APPARATUS FOR
MAKING COMPOSITE

Fig. 5

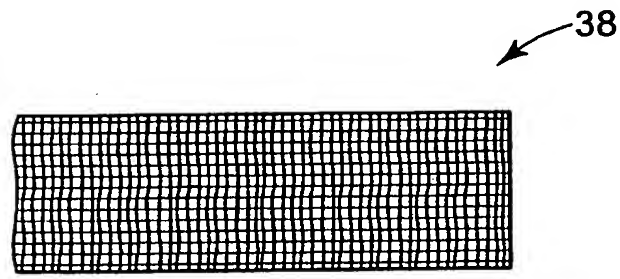


Fig. 6

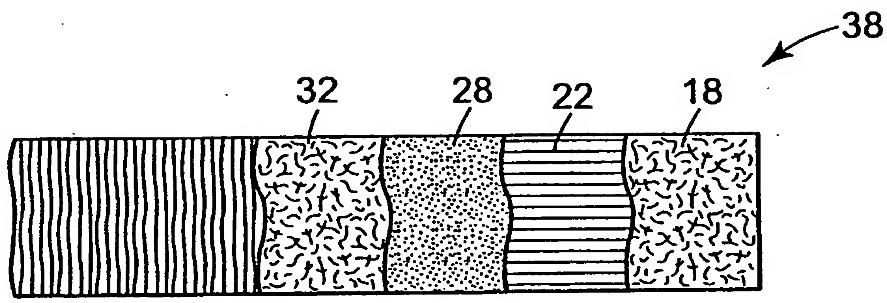


Fig. 7

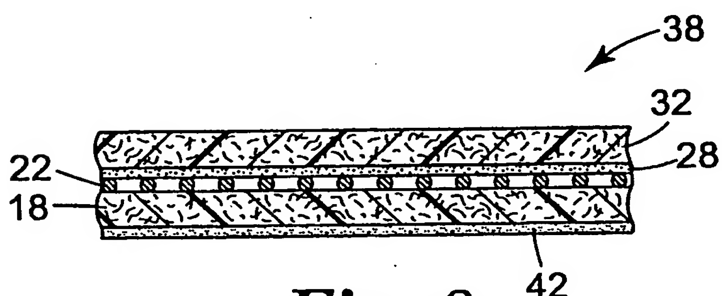


Fig. 8

Fig. 9

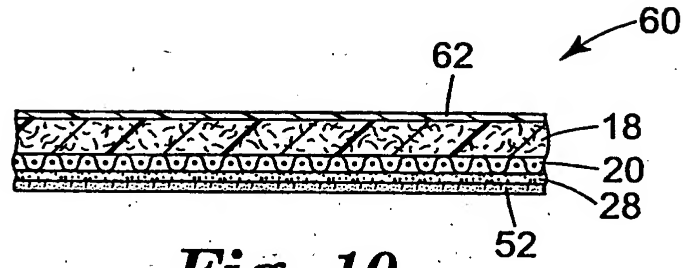


Fig. 10

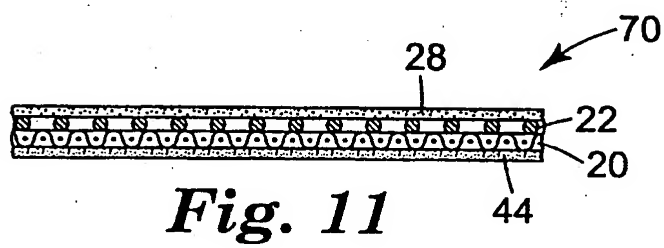


Fig. 11

Fig. 12

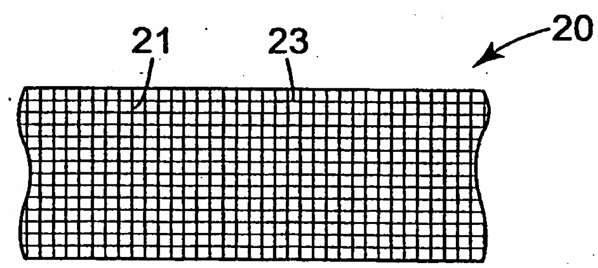


Fig. 13

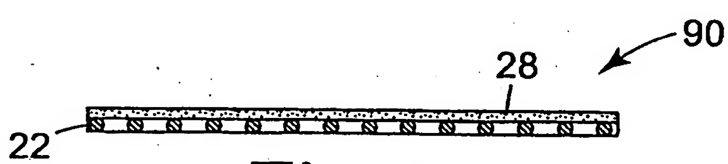


Fig. 14

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/US 99/23003

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B5/08 B32B5/26 D04H13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 432 763 A (KIMBERLY CLARK CO) 19 June 1991 (1991-06-19) claims 1,4,7,9,10,19 page 4, line 25 - line 40	1-12
A	US 4 522 863 A (KECK DANIEL H ET AL) 11 June 1985 (1985-06-11) claims 1,3 column 2, line 57 -column 4, line 27 column 5, line 3 - line 8	1-12
A	WO 98 02610 A (KIMBERLY CLARK CO) 22 January 1998 (1998-01-22) claims 1,13-16 page 13, line 32 -page 14, line 19	1-12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2000	02/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Girard, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 99/23003

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